(7 pages) **Reg. No. :** .....

Code No.: 6522 **Sub. Code: ZPHM 11**

M.sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2021

First Semester

Physics – Core

CLASSICAL MECHANICS

(For those who joined in July 2021 onwards)

Time : Three hours Maximum : 75marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. The generalized coordinates are

   (a) Dependent

   (b) Independent

   (c) Cartesian coordinates

   (d) Spherical polar coordinates

2. If a coordinate does not appear in the Lagrangian, then the corresponding conserved quantity is

   (a) linear momentum

   (b) generalized momentum

   (c) angular momentum

   (d) mechanical energy

3. Rutherford's differential scattering cross- section

   (a) has the dimensions of solid angle

   (b) has the dimensions of area

   (c) is proportional to the square of the kinetic energy of the incident particle

   (d) none of the above

4. The maximum and minimum velocities of a satellite are v_1 and v, respectively the eccentricity of the orbit of the satellite is given by

   (a) $e = v_1/v_2$ (b) $e = v_2/v_1$

   (c) $e = \frac{v_1 - v_2}{v_1 + v_2}$ (d) $e = \frac{v_1 + v_2}{v_1 - v_2}$

5. The poisson bracket of two integrals of motion is

   (a) zero (b) unity

   (c) infinite (d) integral of motion

6. If L and K are Lagrangian in old and new variables then the transformation is canonical if

(a) $L + K = \frac{dF}{dt}$ (b) $L - K = \frac{dF}{dt}$

(c) $\frac{L}{K} = \frac{dF}{dt}$ (d) $LK = \frac{dF}{dt}$

7. A rigid body moving freely in space has _____ degree of freedom

(a) 3 (b) 4

(c) 9 (d) 2

8. The actual number of degrees of freedom can be obtained simply by subtracting the number of constraint equations from

(a) N (b) 2N

(c) 3N (d) N/2

9. Momentum four vector

(a) is space like

(b) is time like

(c) has magnitude unity

(d) has magnitude zero

10. At What velocity will be mass of an object will become twice its rest mass?

(a) $\frac{c}{2}$ (b) $\frac{\sqrt{3}}{2}$

(c) $\frac{c}{\sqrt{3}}$ (d) $\frac{c}{\sqrt{2}}$

PART B — ($5 \times 5 = 25$ marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) State and prove D'Alemberts principle.

Or

(b) Obtain the equation of motion of a system of motion of a system of two masses, connected by an inextensible string passing over a small smooth pulley.

12. (a) Explain reduction of two body problem to the equivalent one-body problem.

Or

(b) Obtain the different equation for the orbits.

13. (a) Discuss the Hamilton – Jacobi theory. In What circumstances is the characteristic function W more useful than the special function S.

Or

(b) Show that transformation defined by $q = \sqrt{2P}\sin Q, P = \sqrt{2P}\cos Q$ canonical by using poisson bracket.

14. (a) Show that the kinetic energy of a rotating rigid body can be expressed as $T = \frac{1}{2} I.\omega^2$

Or

(b) Explain the moments and products of inertia.

15. (a) Find the velocity at which the mass of a particle is double its rest Mass.

Or

(b) Define a four vector. How are the components of the four momentum vector related to the three momentum of a particle.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)
Each answer should not exceed 600 words.

16. (a) Derive Lagrange's equation from Hamilton's principle.

Or

(b) Use Lagrange's equation to find the equation of motion of *a* compound pendulum. Which oscillates in a vertical plane about a fixed horizontal axis. Hence find the period of oscillation of the of the compound pendulum

17. (a) State and prove viral theorem.

Or

(b) Explain classical scattering in a laboratory and center of' mass Systems.

18. (a) Determine the frequency of kepler problem using action angle variable for a particle in an inverse square central force field.

Or

(b) What is generating function? Obtain canonical transformation. Equations corresponding to first three types of generating functions.

19. (a) Determine Euler's angles and Obtain an expression for the complete transformation matrix.

Or

(b) Discuss the theory of a Spinning top under gravity.

20. (a) Shows that covariance of Maxwell field equation under Lorenz transformations?

Or

(b) Obtain the relativistic Hamiltonian equation.

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